required to achieve cleanup standards without long-term groundwater treatment. Specifically, elimination of at least 99% of the CKD-groundwater contact is required to achieve cleanup standards [GeoSyntec, 2004]. Nevertheless, PSR is the "baseline cleanup action alternative" for comparison with the other alternatives. The disproportionate cost test is described in WAC 173-340-360(3)(e)(i) as follows:

Test: Costs are disproportionate to benefits if the incremental costs of the alternative over that of a lower cost alternative exceed the incremental degree of benefits achieved by the alternative over that of the other lower cost alternative.

Although PSR is the baseline alternative in terms of its degree of permanence, PSR is very difficult to implement and its cost is disproportionate to the benefits of the alternative. PSR involves significant risks in the short term and difficulties in implementation. PSR also effectively destroys the engineered cover. Accessing the inundated CKD at the base of the Closed CKD Pile involves very complex construction systems. Expanding the excavation to remove more CKD than planned once the base is reached requires that the entire excavation be restarted to yield the proper excavation. Based on the current Ecology interpretations of the inundated portions of the Closed CKD Pile, PSR displaces about 270,000 cubic yards, approximately half of the pile. In addition, PSR costs about two to three times more than the ASC alternative and an order of magnitude more than PASC and the other alternatives. Estimates show PSR installation to cost approximately \$17 to \$24 million. Although not quantifiable, PSR reduces the generation of groundwater requiring Even if groundwater treatment was no longer necessary immediately following CKD excavation, estimates show that PSR would still be more costly than any of the other five alternatives operating indefinitely. Thus, PSR is impracticable and risky, and its cost in terms of dollars, implementability, and short-term risks is disproportionate to the benefits provided. Furthermore, contractors have recommended that PSR not be attempted at the Site.

The ASC cost is also disproportionate to the benefits achieved (see Exhibit ES-4). The incremental increase in cost over GWC, FGT, PTW, and PASC is substantial. The estimates show that ASC costs between \$9.1 to \$14 million in capital expense, of which the source control components cost \$8 to \$13 million and the downgradient groundwater control and common components total approximately

\$4.3 million in present value. As downgradient groundwater control alone will achieve cleanup standards in the same time frame as the ASC, the ASC alternative would require spending \$8 to \$13 million with limited environmental benefit. Assuming optimistically that the slurry wall reduces the volume of affected groundwater by 50 percent, then the present value cost savings realized by adding the downgradient groundwater control components would be approximately \$600,000. This amount reflects reduced treatment costs such as pumping, chemical usage, and solids handling. Spending an additional \$8 to \$13 million on the capital costs of the ASC components alone, to save at best \$600,000 over an uncertain volume of the CKD-affected groundwater plume, is a disproportionate cost. PASC will also achieve source control using passive systems (i.e., gravity drain) at approximately one-third the cost of ASC.

PASC, a more cost-effective alternative, offers a more promising option to meet applicable remedy selection criteria. PASC includes a source control component, the gravity drain, combined with the passive funnel system of slurry walls to direct the groundwater to an in situ treatment zone. The FGT components of PASC achieve compliance with cleanup standards, whether the gravity drain is added or not. However, the gravity drain is a relatively cost effective method to reduce the volume of water that contacts the CKD.

PASC, PTW, GWC, and FGT have similar costs, and all meet cleanup standards. In addition, all four reduce the mobility and toxicity of hazardous substances. However, PASC (and to a lesser extent, FGT) has a higher degree of permanence than PTW and GWC because it also reduces the volume of hazardous substances in groundwater. PASC offers this additional permanence without greatly elevating costs, implementability concerns, or short-term risks. Based on the disproportionate cost analysis provided in WAC 173-340-360(3)(e), PASC uses permanent solutions to the maximum extent practicable.

5.4 **Provide a Reasonable Restoration Time Frame**

Section 4 presented an analysis of restoration time frames for the alternatives in accordance with MTCA and the 1999 AO. All six alternatives provide for a reasonable restoration time frame. Except for the first groundwater treatment scenario used for PSR, all alternatives will meet cleanup standards in the same approximate time

frame. Under the first PSR groundwater treatment scenario, the treatment component would allow the alternative to achieve cleanup standards initially at the conditional POC. Moreover, under this scenario, the cleanup standards at a standard POC would be met in approximately five years. However, as discussed above, Lehigh believes this assumption is unrealistic. It is more realistic to assume that, because PSR removes only part of the CKD in contact with groundwater and does not address potential for sidewall seeps intrusion into the Closed CKD Pile or other long term changes in hydrogeologic conditions, treatment would instead continue indefinitely. Therefore all alternatives would meet cleanup standards, at a conditional point of compliance, in the same approximate time frame.

5.5 Consider Public Concerns

The MTCA public review process will give the public several opportunities for input to the remedy selection process. The public will also have the opportunity to review and comment on the project documents. Ecology will address public concerns before finalizing this document. Therefore, public comment will be considered for each of the alternatives, giving them the same ranking for this criterion.

5.6 Prevent Domestic use of CKD-Affected Groundwater

Section 4 evaluates the alternatives based on this criterion. This is not a discriminating factor because under each alternative Lehigh will record restrictive covenants that will prohibit the domestic use of CKD-affected water on its land (see Exhibit ES-4).

5.7 Results of Comparative Analysis

Although GWC is the most cost-effective alternative that will satisfy the MTCA criteria, PASC balances the applicable remedy selection criteria in a way that meets cleanup standards, provides a significant degree of permanence, and reduces the short-term risks, implementability concerns, and high cost associated with PSR. PASC is recommended as the final remedy at the Site in preference to GWC, FGT, PTW,

ASC, or PSR. Exhibits 4.1-1 through 4.1-6 present the evaluations of each alternative with respect to the selection criteria, and a comparative summary. Overall, PASC ranked "very high" in relation the other alternatives, with GWC ranking "high." Although PTW and FGT rank "high" as well, the relative inflexibility of these systems, combined with the higher capital (construction) costs, place them lower in rank when compared to GWC. Although PASC costs slightly more than PTW and FGT, PASC includes a source control with a high degree of permanence that is not cost-disproportionate.

PASC offers the following key advantages:

- Meets cleanup levels and ARARs and therefore provides protection of human health and the environment;
- Uses demonstrated and proven technologies that are technically and administratively implementable;
- Has a high degree of permanence because it will permanently reduce the toxicity and mobility of arsenic in groundwater;
- Reduces the volume generated of CKD-affected groundwater;
- Avoids the construction risks, technical implementability problems, and high cost of PSR; and
- Exhibits a high amount of benefit for the costs incurred.

6. CONCLUSIONS

6.1 Feasibility Study Conclusions

Ecology began its regulatory oversight of the investigation/remediation of the Site in 1991. Lehigh has implemented remedial actions at the Site since 1996 to address potential CKD exposure pathways including direct contact, inhalation, and water infiltration into the Closed CKD Pile. These actions were completed under the authority of hazardous waste management regulations, and were characterized as "CKD Pile Closure." They have been effective and important remedial measures. The closure "source control" measures, the cover and surface water management facilities, have performed as designed.

After the completion of the above-noted remedial measures, groundwater (including its potential impact on Sullivan Creek) remained the medium of concern. Consequently, Ecology required Lehigh to address the CKD-affected groundwater downgradient of the Closed CKD Pile. Significant investigatory work, documented in a series of reports and culminating in the Remedial Investigation Report, determined that the CKD-affected groundwater exceeds MTCA cleanup levels for pH and arsenic. In addition to investigatory work, Lehigh conducted a significant interim action in 1998, when it re-graded the WDOT "deck" to fill low areas where seeps of high pH groundwater ponded, posing a potential risk of direct contact.

This Revised dFSTR evaluates six alternatives, screened from a list of 20, and recommends a remedy in accordance with Washington Administrative Code (WAC) 173-340-350 et. seq. and the 1999 AO. After a thorough evaluation and comparison of the alternatives using the MTCA and 1999 AO criteria, and several discussions and meetings with Ecology over the past year, Lehigh concludes that Partial Additional Source Control (PASC) (a combination of source control and downgradient in situ groundwater treatment) provides the most effective and practical remedy for the Site. The PASC alternative balances applicable remedy selection criteria in a way that meets cleanup standards and best comply with Washington State procedures, regulations and laws.

PASC:

• Implements a practical source control technology that reduces the volume of water that contacts CKD, decreasing the size of the CKD-affected groundwater plume over the long term;

- Uses a demonstrated groundwater treatment technology that will meet cleanup levels and ARARs, and therefore protects human health and the environment;
- Exhibits a high degree of permanence because it provides in situ groundwater treatment that irreversibly treats the constituents of concern (pH and arsenic), permanently reducing their toxicity and mobility;
- Exerts a great degree of control over the groundwater, reducing the potential for gaps in treatment;
- Has a construction cost that is reasonable when compared to the less practical and more risky PSR and ASC alternatives;
- Produces no residual waste; and
- Achieves the greatest benefit for the least cost.

For these reasons, Lehigh recommends PASC as the Site remedy.

6.2 Next Steps

Following finalization of the FSTR, Ecology drafts the CAP. The CAP outlines final design elements for the Site groundwater remedy. Lehigh incorporates the design elements described in the CAP into the final design documents. The design documents show details such as the actual remedy component layout, operating parameter calculations, and design details of the selected alternative.

Lehigh will install and operate the remedy components in compliance with the documents prepared during detailed design, as follows:

- Site Operations Plan, including Operation and Maintenance Manual;
- Compliance Monitoring Plan;
- Health and Safety Plan;
- Contingency Plan; and
- Conditions of required permits and regulatory approvals.

Ecology will review and approve these documents during the design phase prior to initiation of remedy installation field activities.

6.3 Implementation Schedule

Lehigh is committed to implementing the selected groundwater remedy as soon as feasible. Exhibit 6.4-1 presents a preliminary schedule for design, procurement, and installation of system components for the PASC remedy. Actual construction depends on:

- Regulatory review and permitting time frames (primarily the NPDES process);
- Coordinated public participation; and
- Favorable weather conditions.

The schedule will be updated during the final remedy selection process, as well as during the design and procurement phases, in preparation for full-scale field installation.

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